U.S. EPA POSITION PAPER REGARDING THE NEED FOR A HYDROLOGIC AND HYDRAULIC MODEL TO EVALUATE THE POTENTIAL IMPACTS TO THE UPPER WOLF RIVER WATERSHED, THE SWAMP CREEK WATERSHED AND PICKEREL CREEK WATERSHED DUE TO THE PROPOSED CRANDON MINE PROJECT

12/16/96
Revised 5/13/97

Introduction

Crandon Mining Company (CMC) has proposed to mine an area just south of Crandon, WI. The mine will be approximately 2000 feet deep, 100 feet wide and nearly a mile in length and will be mined primarily for zinc and copper. Due to the depth of the proposed mine, groundwater, approximately 820,000 gallons per day, will be pumped from the mine area, treated and discharged out of the Upper Wolf River watershed. This groundwater extraction will cause a drawdown of the groundwater, which may cause changes in the watersheds surrounding the project site area. Other site related and non-site related activities, such as the clear cutting of trees for mine buildings and disposal areas, building access roads and rail spur lines, increasing housing and buildings within the watershed, potentially changing drainage patterns and surface water flows, may combine with the effects of the groundwater drawdown and may lessen or increase the effects of the groundwater drawdown alone.

To evaluate the potential effects of watershed impacts due to the proposed mine, the United States Environmental Protection Agency (EPA) will apply a hydrology and hydraulic model (H&H model) that will further expand on the data and evaluations already, or soon to be generated by the two, CMC's MODFLOW and the U.S. Army Corps of Engineers' (COE) FEMWATER, groundwater models. This position paper will delineate the reasoning for choosing a modeling approach and why it is needed to help the COE make a technically sound decision at the conclusion of the National Environmental Policy Act (NEPA) decision-making process.

An H&H model is essentially a tracking system of fate and transport of precipitation on a watershed, including uplands, outlets and low-lying areas, ground water and surface water bodies, and terrestrial and aquatic habitats. Simpler models predict impacts from increases in impervious area or man-made drainage systems on storm peaks in streams. Typical examples of well-used models are HEC-1, TR-20 and HEC-2 by COE. The Natural Resources Conservation Service (NRCS) uses H&H modeling to predict soil loss or nutrient loss from fields and then predicts the effectiveness of erosion control techniques. The United States Geological Survey (USGS) works with HSPF (Hydrologic Simulation Program - Fortran) to analyze stormwater impacts, solute transport and watershed management plans based on 20 to 30 years of continuous time series data of precipitation, solar radiation and surface temperature.

The above mentioned ground water models, which have components, or modules, to estimate the changes in flows in surface water bodies due to changes in flows in the groundwater, do not directly nor in detail account for the entire water balance for each season or month of the year. These models do not attempt to recreate the processes of erosion, runoff, snowmelt, evapotranspiration, interception and interflow, to name a few of the hydrologic processes which the placement and operation of the mine and TMA will affect. HSPF is capable of recreating these processes and can be used on various scales, which include a watershed or catchment scale that includes not only surface water bodies but describes terrestrial phenomenon and ground water effects.

This level and range of detailed description of the hydrologic system is important for three reasons:

1. It will confirm CMC's data and conclusions, by a different but equally valid approach. Modeling demands a great deal of data and this includes not only data presented in the EIR, but data which has been gathered by public agencies or private parties outside of the CMC data collection effort. This additional data which is required for the model will be used for reviewing CMC's baseline assessment and impact scenarios for the Environmental Impact Statement (EIS) review.

2. It will provide EPA with sufficient information on cyclic hydrologic phenomena to make a quantitative judgment of possible hydrologic impacts of the mining project on the surrounding wetlands, Swamp Creek, Rice Lake and Mole Lake, and the surface waters on and around CMC property.

3. Further, output of the H&H model will be examined to estimate changes in plant and animal communities based on the change in hydrologic patterns, therefore a change in habitat, due to mining impacts. CMC's current Environmental Impact Report (EIR) does not examine the affected area in this temporal or functional detail.

The current scientific thinking describes a watershed not as a conduit of stormwater, but as an integrated series of habitats which plant and animal communities have evolved to use in the most efficient manner. This includes terrestrial and aquatic habitats, the interfaces between land and water, ground water and surface water (wetlands, hyporheic region) and upland and lowland. The evolution of animals and plants associated with the affected habitats is also a response to the cyclic changes in climatic variables over the year. Although the EIR estimates yearly average water balances and stage/discharge relationships on surface water bodies within the CMC property, an integrated study of the Swamp Creek and Pickerel Creek Watersheds' responses to seasonal fluctuations is missing. This description needs to include, using wetlands as an example, delineation of wetlands based on hydraulics, morphology, soil type, plant and animal community types and an estimate of the range of hydrologic conditions to support the specific wetland type. The interactions between habitat and biota need to be represented in a quantitative manner at appropriate temporal resolutions. Each wetland, lake and homogenous stream reach has associated plants and animals adapted to its seasonal hydrology and the climate - the tolerable ranges for an indicator of each community will be reviewed in the literature. That tolerance range in velocities, flows, surface elevations or seasonal fluxes will be compared with the changes in hydraulics and hydrology due to mining impacts estimated by the model and a quantitative estimate of the area of change and rate of change due to the impact will be made by ecologists.

In order to make a quantitative assessment of impacts on aquatic habitats, a model of the water balance, the surfaces and associated landcovers with the cyclic changes of climate over the year, and over different geographic scales provides the information needed to judge possible impacts on the instream, benthic, littoral and hyporheic habitats. A dynamic model, which provides a cyclic distribution of water balances within a watershed, will provide a logical construct of the naturally occurring hydrologic fluctuations based on historical data. Then, changes will be made to the model's input to simulate changes proposed in CMC's EIR in terms of changes in the water table, pervious and impervious land area, erosion, etc., due to construction activities of the plant area and the Tailings Management Area (TMA), mine operation and closure. Given the potential seriousness of the possibilities of mining impacts on such a geologically and hydrologically complex area, the modeling provides an examination of the entire hydrologic cycle with an emphasis on surface waters as thorough as the ground water flow, but which the EIR provides unintegrated and insufficient data.

Therefore, the objectives for review of the CMC EIR/EIS for water quality and quantity baseline assessment and impact development by EPA, Region 5, are:

1. Review and corroborate existing data from Crandon with other sources;
2. Delineate the subwatersheds to determine the areal extent of possible stressors;
3. Quantify potential impacts of changes to the water budget due to construction;
4. Quantify the potential impacts of changes to the water budget due to operation of mine under various conditions such as seasonal, yearly or multi-year drought and flooding;
5. Quantify the potential impacts of changes to the water budget post-closure, especially those effects of changes in recharge and runoff patterns due to the TMA;
6. Quantify impact of hydraulic and chemical impacts on wild rice and other indicator or significant aquatic biota; and,
7. Transfer data to various Agencies and Tribes in fulfillment of Trust Responsibilities to Tribes.

HSPF, a hydrology and hydraulic model, which will define current hydrologic, climactic and landcover interactions within the Swamp Creek and Pickerel Creek watersheds, will be used in conjunction with ecologists who will evaluate the hydrological output in terms of aquatic habitat baseline functioning and possible impacts by mine construction, operation and closure.

There are six general categories of input for HSPF:

1. Precipitation (rain and snow)
2. Temperature (air, surface water, soils)
3. Pervious/Impervious
   - Current and Potential Land Use
   - Soil type
   - Vegetative Cover
     - wetland types
     - forest types
     - agricultural land uses
     - riparian corridor types
     - logged and non-logged areas
   - Slopes
   - Quantify current and potential impervious areas
     - roads, sidewalks, parking lots, driveways
     - housing
     - commercial buildings
     - industrial sites
     - public buildings
4. Snowmelt Discharge
   - Snow pack (discharge from melting snow, ice, water)
   - Sediment
5. Hydraulic Routing of surface water and ground water
   - groundwater/surface water interaction (FEMWATER input)
   - baseflow
   - surface streams
     - confluences with lakes, streams and wetlands
     - controls
     - flow, velocity and surface elevations
     - morphology
   - wetlands
     - connections with groundwater
     - flow, velocity and surface elevations
     - soils
   - lakes
     - controls
     - flow, velocity and surface elevations
     - bathymetry
6. Sediment/Solids Loading and Delivery
     - Upland soil type contributing to erosion
     - Upland slope
     - soil moisture
     - solids characterization

The high resolution area will be 3 mile radius around the mine site and will include Swamp Creek and Pickerel Creek watersheds, Rice Lake, Swamp Creek, Mole Lake, in addition to water bodies already described in the EIR. The low resolution area will be the three watersheds comprising the Upper Wolf Watershed and will be used to organize data and double-check the high resolution results.

Outputs which will be used to examine conclusions of negligible impact on surface water bodies in the high resolution area are:

Surface elevations, flows, velocities of water bodies, and water temperature.

In combination with ecologists, the hydrologic and hydraulic scenarios will be analyzed for compatibility with known ranges of hydrologic fluctuations to which the current plant and animal communities are adapted. The scenarios of mine impacts to monthly or seasonal fluctuations of hydrologic fluctuations will also be analyzed by ecologists. The scenario analysis will provide

some indication of possible plant and animal community changes if there are changes in the hydrology.

The following scenarios which will be developed:

I. Construction Simulation
   Deforestation, change in pervious area, erosion, sediment loading and delivery
   Subdivision development
II. Operating Simulation
   Dewatering, change in pervious area,
III. Post-Closure Simulation
   TMA effects on runoff, infiltration and interception patterns

For each of the above scenarios, a series of simulations will be made for average conditions, drought conditions and flood conditions. The scenarios will then be analyzed by ecologists:

A. Examination of changes in seasonal hydrologic fluctuations during drawdown and comparison with current aquatic habitat hydrologic ranges
B. Examination of changes in monthly hydrologic fluctuations during drawdown and comparison with current aquatic habitat hydrologic ranges

C. Examination of changes in sediment loading during construction and comparison with current aquatic habitat loading ranges
D. Examination of changes in sediment loading during operation and comparison with current aquatic habitat embedding

EPA will run two modeling efforts:

* The first modeling effort will be a screening model to provide a conceptual model and data management using the H&H modeling System (WMS), in order to address missing or inadequate data in our review of the EIR on climate, hydraulics of surface waters and erosional impacts of construction and increase in impervious areas through plant construction, road construction and additional housing, the monthly impacts on surface waters of the projected drawdown, and the effectiveness of the stormwater runoff controls on the site.

* The second modeling effort will be to use HSPF to address the detail needed for a watershed-wide analysis of the impacts from an increase in impervious areas and from the drawdown effects on aquatic habitats and aquatic organisms over several decades. HSPF has the capability to provide groundwater/surface water interactions, erosion estimation and sediment transport effects on a monthly basis and account for snowfall and springmelt. Ecologists will then use this information to evaluate the potential impacts to current aquatic habitats. HSPF will be used in conjunction with the COE modeling effort, which is the use of FEMWATER, to corroborate the MODFLOW results by CMC. The results of the FEMWATER modeling will be used as input/confirmation of the HSPF model.

National Environmental Policy Act

The purpose of the H&H model, proposed and to be implemented by the EPA, is to contribute to the federal NEPA process for the Crandon Mine project. Section 1500.1(b) [Purpose] of NEPA states that the: [Bold-italic print is the language from the NEPA regulations throughout this section.]

NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

EPA believes that the data and evaluations currently available regarding the potential effects to the watersheds and ecosystems surrounding the proposed mine site are lacking certain information, as outlined below, and to this end, the important data gaps will be filled by implementing a model of the watersheds most likely to be affected.

The current EIR does not provide a detailed description of watershed functioning on a level of resolution that allows for examination of current aquatic habitats, hydrologic integrity and areas of hydrologic vulnerability. In addition, if reasonably reliable projections of potential impacts from not only the primary activity of mining, but the secondary impacts of increased traffic, housing construction, associated public and private sector landscape changes, etc., are to be made, then a detailed model which can accommodate various prediction scenarios must be constructed, using a complete, thorough and detailed model of the current functionality and structure of the affected watersheds.

If EPA is to ensure that a detailed hydrologic and hydraulic watershed analysis is to be made available to citizens, this Agency must perform a watershed assessment and analysis independent of the applicant. EPA will ensure that the information is provided in an organized and intuitively understandable format and available in a variety of formats - hardcopy and electronic and via ftp, telnet and postal service. Currently, information has not been made available to all public officials at this time in the format requested - the current format of the data in hardcopy does not provide the accessibility intended by NEPA.

Section 1500.1 of NEPA continues to state that:

Most important, NEPA documents must concentrate on the issues that are truly significant to the action in question rather than amassing needless detail.

Potential impacts from the proposed Crandon zinc and copper mine to the individual watersheds comprising the headwaters of the pristine Wolf River (designated as a State Outstanding Resource Water) and surrounding the proposed Crandon Mine project site are of obvious significant concern to all parties involved in the permitting of the mine as well as to all those residing in the area, including the four tribes of Native Americans residing within the Upper Wolf River Basin. Since all the aquatic resources in the Upper Wolf Watershed are designated by the Wisconsin Department of Natural Resources (WDNR) as fully usable, the potential of any permanent damage to those designations must be considered significant due to the fact of the rarity of such undeveloped watersheds. Information to be gained by the application of the H&H model is not considered as needless detail by the EPA, but will confirm/refute data and evaluations generated by others and will add additional data and evaluations regarding a potential irrevocable loss of an already threatened ecosystem by the project and will assist in making an informed decision under the NEPA process.

According to Section 1508.27 [Significantly] of NEPA,

"Significantly" as used in NEPA requires considerations of both context and intensity:

(a) Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

At present, there are two groundwater models, MODFLOW and FEMWATER, being conducted by CMC and the COE, respectively. These models evaluate groundwater systems and include surface water components, taking into account some ground water-surface water interactions. The H&H model to be implemented by the EPA, on the other hand, looks at the region-wide surface water system and has groundwater components to it, as well as other input values such as detailed below. The intent of the H&H model is not to duplicate the extensive research and efforts put into the groundwater models but to confirm, expand on and add pertinent information relating to the potential impacts to vulnerable aquatic habitats from not only the drawdown of local groundwater by the mine, but also potential effects of other mine activities such as road construction, land clearance, wetland loss, housing etc. EPA's Watershed approach will look at both the short- and long-term effects of the proposed mine's potential effects on the watershed systems and will look at the effects in a more holistic manner than will either the CMC's MODFLOW or COE's FEMWATER groundwater models.

Significant issues that the groundwater modeling does not address but will be by the H&H model are:

* Local - Landscape changes affecting streams and wetlands as habitats and hydrologic entities and as parts of an undeveloped, fully functioning watershed before drawdown and 100 years after mine closure.
* Regional - Landscape and hydrologic changes affecting watershed hydrology as part of the Upper Wolf River drainage basin over several decades.
* Social - Landscape changes affecting cultural activities, recreational activities and subsistence activities such as loss of coldwater fisheries, wild rice gathering, trapping, hunting.

NEPA Section 1508.27 continues:

(b) Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

As this section of NEPA indicates, each agency may have different approaches or need different information to address different aspects of a major action for a project and to contribute to the decision process. EPA recommends the use of a H&H model in order to more fully understand the complexities of the Upper Wolf River Watershed and the potential impacts from the proposed mine. Section 1508.27 (b) continues, along with how it applies to EPA's pursuit of the H&H model, as follows:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.

The Watershed Approach, of which the H&H model is an integral tool, is all-inclusive and evaluates the current healthy and unhealthy aspects of the watershed to provide a deep understanding of the complex interactions between meteorology, lithology, hydrology, chemistry, biology and topology in order to manage any impact - adverse or beneficial.

(2) The degree to which the proposed action affects public health or safety.

The effects of all potential impacts, alone and in combination, of the construction and operation of a mine which have a potential affect on public health and safety need to be understood prior to decisions made under NEPA. A study, such as the EPA's H&H model, in addition to the other studies being or already conducted, needs to be run to estimate the potential degree of impact on a watershed level. A watershed approach includes analysis of impacts on humans such as effects on drinking water, recreational use, subsistence food gathering and other cultural uses, etc., and integrates these effects over time and over the affected area.

The H&H model results may later contribute to, but not limited to, the evaluation of fate and transport of heavy metals due to erosion, air deposition, and surface and subsurface acid drainage.

(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas.

Unique characteristics such as the close proximity to the Native American tribal reservations and the cultural resources associated with the tribes, as well as the nearness of the Wolf River, designated as an outstanding water resource, the Nicolet National Forest and the Highland Legion State Forest, highlight the applicability of this criteria for the need to gather enough information, via the H&H model as well as other models and data generated, to understand these significant features and the potential impacts which may be caused by the proposed project.

In addition, this area, in particular, contains many levels of unique habitats for amphibians, animals that are currently facing an unexplainable decline in numbers all over the world. The information needed to understand impacts on amphibian habitat, such as monthly distributions of surface water elevation and flows, are not outputs of the groundwater models.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

Due to the nature of this project, the pros and cons of this project are highly controversial with strong issues both for and against the mine. The H&H model will add data and evaluations in areas that are controversial, such as potential effects on cultural resources and the total impacts of groundwater drawdown, and will be used to help assist the decision making under the NEPA process.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

FEMWATER and MODFLOW both will answer some of the concerns relating to the groundwater drawdown issue, but both also use a number of assumptions, causing some inherent uncertainties. The H&H model may cover some of the areas of the other models' uncertainties, i.e., being stronger in certain areas, but may have uncertainties in other areas. Together, the models should provide a sufficient data base to understand what is occurring above and below ground in response to potential impacts from the proposed mine, in order to make a technically sound decision under the NEPA process.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

With the possibilities of other mining occurring in the Upper Wolf River watershed area and in other northern Wisconsin locations in the reasonable and foreseeable future, as defined in NEPA Section 1508.7, the use of a H&H model is something that should be set as a precedence in order to understand potential impacts of multiple mining operations to complex watersheds.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

Seemingly individual insignificant mining related activities such as access road construction, clear cutting of trees, groundwater drawdown and diversion, and other activities all may affect a watershed insignificantly as singular occurrences, but combined, the total impact may be more than the sum of the parts. The H&H model will evaluate all these multiple effects and model a cumulative impact over the years of mine operation and after mine closure.

H&H models are, in general, written to describe possible effects of multiple changes within the watershed boundary on aquatic systems. MODFLOW and FEMWATER predict changes in groundwater flow - this does not describe the possible impacts of mine construction and operation to aquatic habitats in surface water and the hyporheic region.

(8) The degree to which the action may adversely affect districts, sites, highways, structures or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

As pointed out under (b3) above, the close proximity of tribal lands and their associated cultural resources is among the reasons to gather all the information necessary, such as from the H&H model, to make a technically sound decision under the NEPA process.

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

Does not directly apply to the application of the H&H model.

(10) Whether the action threatens a violation of Federal, State or local law or requirements imposed for the protection of the environment.

Does not directly apply to the application of the H&H model.

EPA feels that regarding the intensity of the watershed issue, that most of the 10 points above directly apply to this project and therefore believes that the relevance of the above criteria and the need for the H&H model approach is clear. Particularly, items (b) 3-8 can be used to directly endorse the need for a model that takes a differing approach than others being used for the project and that will expand on the data base. These evaluations will further assure that any decisions made under the NEPA process are based on the best available information.

EPA is not a cooperating agency, as defined in Section 1508.5 [Cooperating agency] of NEPA, but is assisting the lead agency, the COE, in gathering and assessing data needed for a full and comprehensive federal EIS. While the COE is evaluating the project via a groundwater model approach, EPA favors a watershed approach, as outlined in this position paper, and feels that the two approaches complement each other and cover areas of significant concern, as mentioned above, that the other does not. EPA also feels that due to the intensity of the significance of the watershed issue, that the use of a third modeling system, the H&H model, for the project is warranted.

EPA Responsibilities

EPA has several areas of involvement and responsibility to this project, not only under the NEPA process, but also pursuant to statutes, Executive Orders and Regional Priorities. EPA has statutory responsibilities regarding oversight of state and federally delegated programs, such as the Clean Water Act, and therefore is involved in reviewing the permits related to this project. The H&H model will help the EPA evaluate the direct and indirect effects of the anticipated groundwater drawdown and will help EPA and the other regulatory agencies determine the extent of applicability of pertinent statutes. In addition, under Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations and as outlined in the draft Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analysis, EPA will use the data and evaluations obtained from the H&H model to help determine direct and indirect effects of the proposed mine and to help determine if any portion of the population is affected more than others, such as whether tribal cultural resources bear more of an impact from the mine than resources of value to other ethnic groups or populations in the area. In addition, the federal agencies involved in this project have statutory Federal Trust Responsibilities to the four federally-recognized Native American tribes that reside within the Upper Wolf River basin, to determine how this proposed mine may effect their cultural and natural resources. EPA feels that CMC's MODFLOW groundwater model does not extend far enough, spatially, to address all potential project-related tribal cultural and environmental concerns. The COE's FEMWATER groundwater model will cover more area than CMC's MODFLOW model, but it will not incorporate all the parameters that the EPA's H&H model will, as described herein. Potential impacts, as described within CMC's EIR, to the area surrounding the proposed mine, regarding the affected environment and to trust resources, had left many issues unaddressed, as outlined in EPA's August 2, 1996 EIR comments. EPA believes that the combination of the data and evaluations obtained by completing the H&H model with the data and evaluations obtained from COE's FEMWATER groundwater model, that many of the important concerns regarding the Upper Wolf River Basin will be more fully evaluated. This will, therefore, enable a more technically sound decision to be made after the completion of the NEPA process, with regard to the potential environmental and cultural impacts within the Upper Wolf River Basin, caused by the proposed mine.